

This presentation should not be considered a final statement of NIOSH policy or of any agency or individual who was involved. This information is intended for use in advancing knowledge needed to protect workers. Comments regarding this presentation may be submitted to the NIOSH Docket Office.

CBRN PAPR Laboratory Respirator Protection Level (LRPL)

Mike Bergman
Respirator Branch
National Personal Protective Technology
Laboratory, NIOSH



Workplace
Safety and Health



CBRN PAPR

Laboratory Respirator Protection Level (LRPL)

- Description- Fit-factor corn oil aerosol test
- Purpose- Establishes a benchmark level of protection under laboratory conditions
- Not intended as an indication of protection in an actual response scenario

CBRN PAPR Laboratory Respirator Protection Level (LRPL)

Challenge Aerosol Criteria

- 20 – 40 mg/m³ Corn Oil aerosol
- 0.4 to 0.6 Micrometer Mass Median Aerodynamic Diameter

CBRN PAPR

Laboratory Respirator Protection Level (LRPL)

Pass / Fail Level

- LRPL = 10,000 for = 95% of test trials
- Tested with PAPR blower operating

CBRN PAPR

Laboratory Respirator Protection Level (LRPL) Subject Exercises

- 1) Normal Breathing,
- 2) Deep Breathing,
- 3) Turn Head Side to Side,
- 4) Move Head Up and Down,
- 5) Recite the Rainbow Reading Passage or equivalent,
- 6) Sight a Mock Rifle,
- 7) Reach for the Floor and Ceiling,
- 8) On Hands and Knees - Look Side to Side,
- 9) Facial Grimace,
- 10) Climb Stairs at a Regular Pace,
- 11) Normal Breathing

CBRN PAPR

Laboratory Respirator Protection Level (LRPL)

Anthropometric Parameters
(if applicable based on PAPR design)

- Neck Circumference
 - (for tight-fitting neck dam hooded models)
- Head Circumference
 - (for tight-fitting neck dam hooded models, 'Large' criteria)
- Face Length
 - (for models with tight fitting face-masks)
- Face Width
 - (for models with tight fitting face-masks)

CBRN PAPR

Laboratory Respirator Protection Level (LRPL)

(LRPL) – Development of Subject Panel

- Anthropometric ranges established as part of CBRN Escape Hood standard
- Reviewed population distributions of head, neck, face length and width sizes
- Based on PAPR design, panel will only require subjects to meet applicable parameters

CBRN PAPR

Laboratory Respirator Protection Level (LRPL)

- ‘Face Length’ and ‘Face Width’ Criteria
 - Adapted from Los Alamos panel report
*Selection of Respirator Test Panels
Representative of U.S. Adult Facial Sizes.*
LA5488. 1974

CBRN PAPR

Laboratory Respirator Protection Level (LRPL)

NIOSH LRPL PANEL

- Based on latest (unpublished) survey data by Zhuang, et. al.
- Survey data conducted for purposes of establishing updated panels for NIOSH respirator certification and international standards
- Subjects recruited from industries nationwide (manufacturing, construction, health care, law enforcement, and firefighting)



Workplace
Safety and Health



CBRN PAPR

Laboratory Respirator Protection Level (LRPL) NIOSH LRPL PANEL

- NIOSH survey: Total Subjects = 3,997
- 2,243 subjects (1,140 male and 1,103 female) had complete measurements for:
 - Face width
 - Face length
 - Head Circumference
 - Neck Circumference
- Compared NIOSH survey data to 1988 Army data* previously considered for LRPL matrix

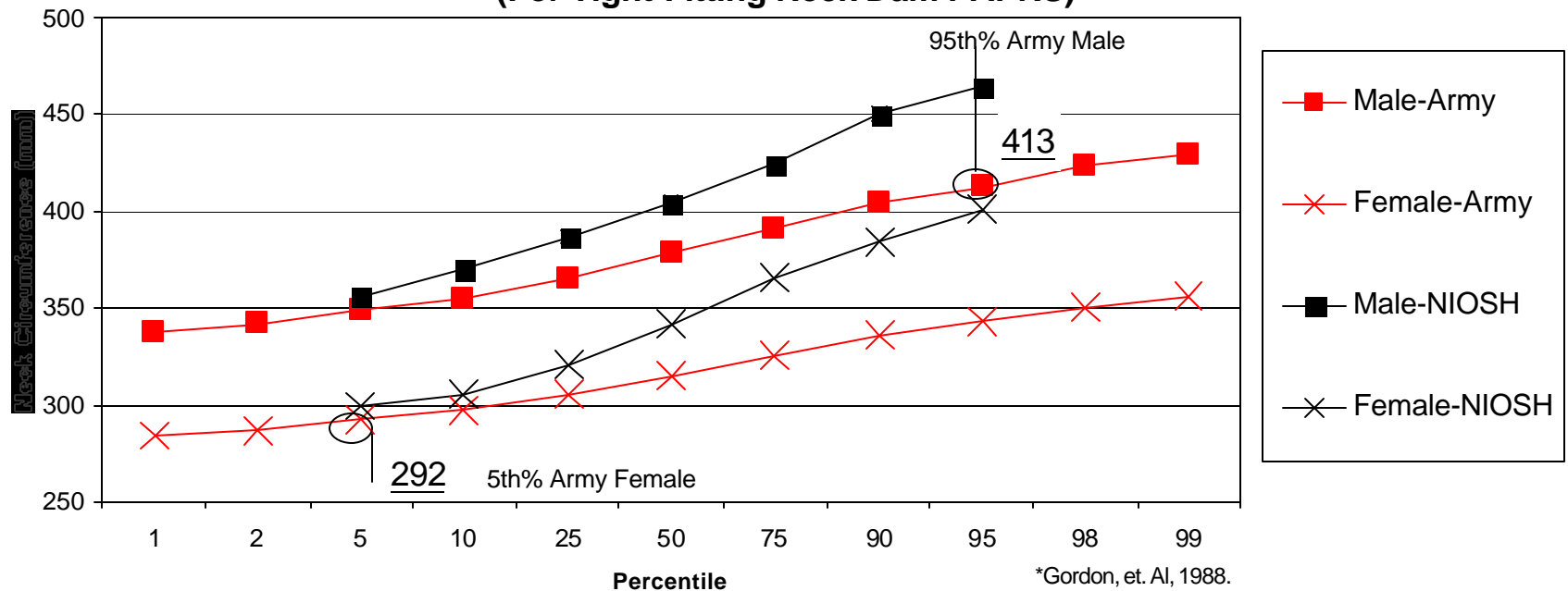
*Gordon, C.C., et al. "1988 Anthropometric Survey of U.S. Army Personnel: Summary Statistics Interim Report." Technical Report NATICK/TR-89/027. Compiled in DOD *Military Handbook Anthropometry of U.S. Military Personnel*. DOD HDBK-743A.



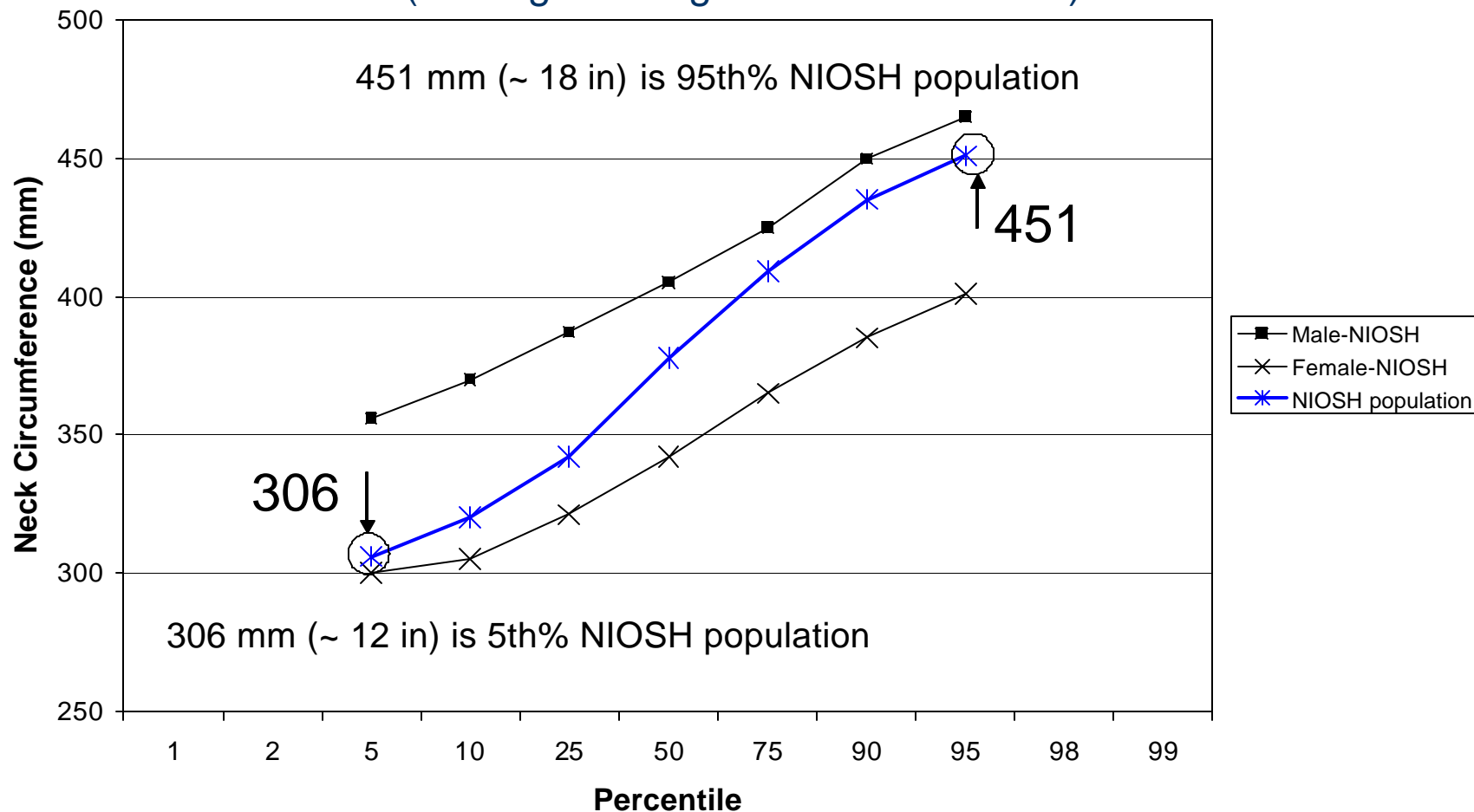
Workplace
Safety and Health



Prior Approach to Neck Circumference Range Using Army Data* (For Tight-Fitting Neck Dam PAPRS)



Current Approach to Neck Circumference Range Using NIOSH Data (For Tight-Fitting Neck Dam PAPRS)



CBRN PAPR

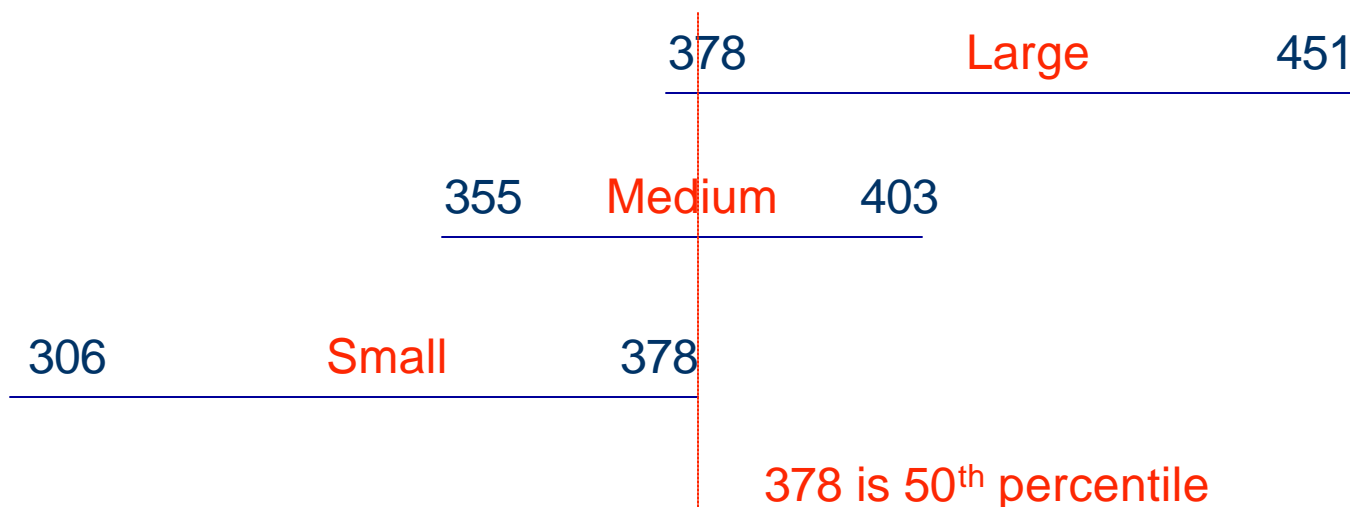
Laboratory Respirator Protection Level (LRPL)

Overlapping Ranges of 'Size' for Neck Circumference

(For Tight-Fitting Neck Dam PAPRS)

Using NIOSH Population Data

- Expanded Neck circumference 'Size' ranges increases the chance of subject overlapping into same 'Size' range of face measurement criteria



CBRN PAPR

Laboratory Respirator Protection Level (LRPL) (For Tight-Fitting Neck Dam PAPRS)

Head Circumferences for 'Large' Criteria (millimeters)

		Lower Boundary (50 th %)	Upper Boundary (95 th %)
Current Approach _____	Population (NIOSH)	570	603
Prior Approach _____	Men (Army)*	568	594

*Gordon, C.C., et al. (1988)









Workplace
Safety and Health



CBRN PAPR

3 Size Model: Test Each Column Corresponding with Unique Size

‘One-Size-Fits-All’: Must Meet Criteria of All 3 Size Columns

	Small	Medium	Large
Face Length and Face Width	Cell A Use LANL boxes 1, 2, 3, 4 (2 or 3 subjects each box, 2 trials per subject) Subjects= 10 Trials= 20	Cell D Use LANL boxes 3, 4, 5, 6, 7, 8; (2 or 3 subjects each box, 2 trials per subject) Subjects= 17 Trials= 34	Cell G Use LANL boxes 7, 8, 9, 10; (2 or 3 subjects each box, 2 trials per subject) Subjects= 11 Trials= 22
Head Circumference  = updated	Cell B N / A Subjects= 0 Trials= 0	Cell E N / A Subjects= 0 Trials= 0	Cell H 568-603  570-603 mm Subjects= 10 Trials= 20
Neck Circumference  = updated	Cell C 292-332  306 -378 mm Subjects= 10 Trials= 20	Cell F 333-403  355 - 403 mm Subjects= 10 Trials= 20	Cell I 374-413  378 - 451 mm Subjects= 10 Trials= 20